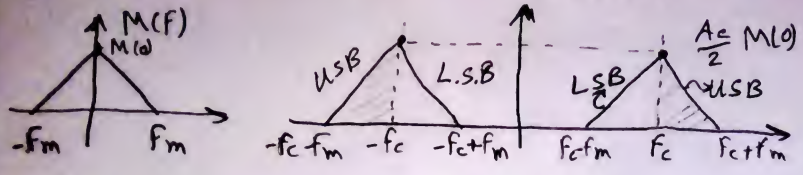
SSB

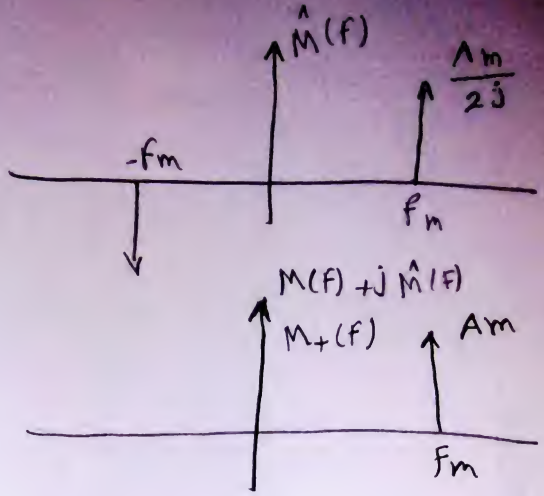
Single Side Band:

DSBSC → $s(t) = A_c\, m(t) \cos(2\pi f_c t)$



B.W = Fm

B.W = 2 fm



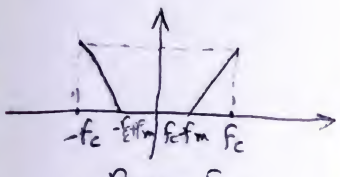
SSB

- We will transmit either USB or LSB which decrease the required B.W. of DSBSC to half
- We will transmit the signal m(t) by its original B.W.

$$M_+(f) = \begin{cases} 2M(f) & F>0 \\ 0 & F<0 \end{cases}$$

$$M_-(f) = \begin{cases} 0 & F>0 \\ 2M(f) & F<0 \end{cases}$$

LSB



BW = fm

USB

BW = fm

$s(t) \Rightarrow M_+(f) \xrightarrow{\text{shift}} f_c$

$M_-(f) \xrightarrow{\text{shift}} -f_c$

USB

$$s(t) = \frac{A_c}{4}\left[m_+(t)\, e^{+j2\pi f_c t} + m_-(t)\, e^{-j2\pi f_c t}\right]$$

$m(t)$ → Message signal

$\hat{m}(t)$ → Hilbert transform (shift a signal 90°)

ex $\sin t \rightleftharpoons \cos t$

$m_+(t) = m(t) + j\,\hat{m}(t)$ يحتوي على تردد موجب فقط

$m_-(t) = m(t) - j\,\hat{m}(t)$ يحتوي على تردد سالب فقط

$e^{j\theta} = \cos\theta + j\sin\theta$

$m_-(t)$, $m_+(t)$ عبارة عن تردد

$$s(t) = \frac{A_c}{2}\left[m(t)\cos(2\pi f_c t) \pm \hat{m}(t)\sin(2\pi f_c t)\right]$$

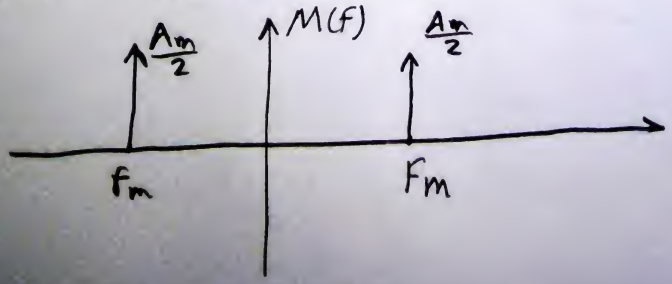
SSB

LSB ← موجب

USB ← سالب

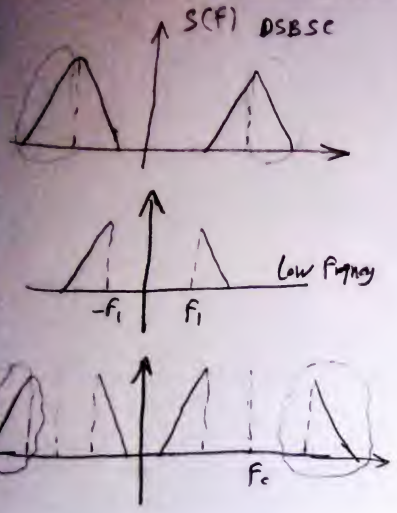
$m(t) = A_m \cos(2\pi f_m t)$

$\hat{m}(t) = A_m \sin(2\pi f_m t)$

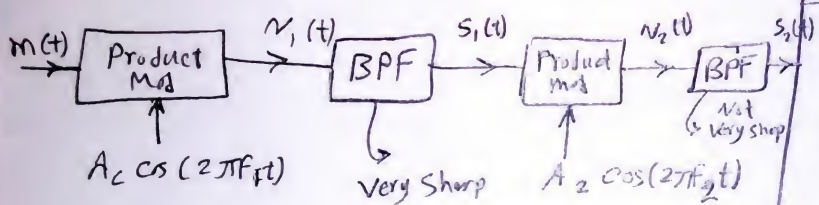


★ Generation of SSB:

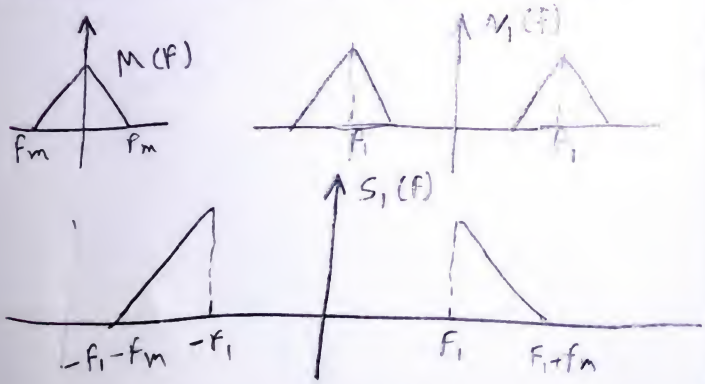
① Frequency discrimination method

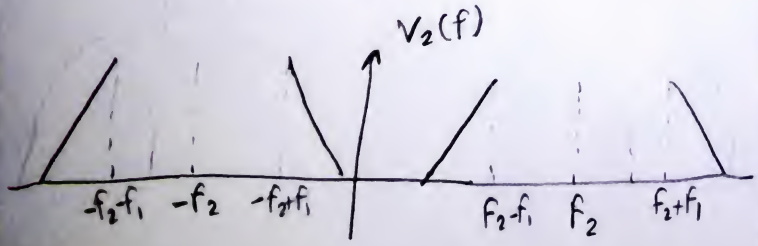


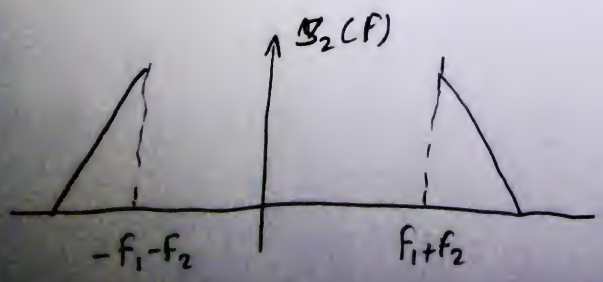
- لا يمكن استخدام Sharp filter لعزل الفصل بسبب التردد العالية
- يتم التعديل على مرحلتين أولاً filter عند تردد منخفض
- ثم تعديل لنقل الإشارة لتردد عالي



Product modulator is DSBSC mod



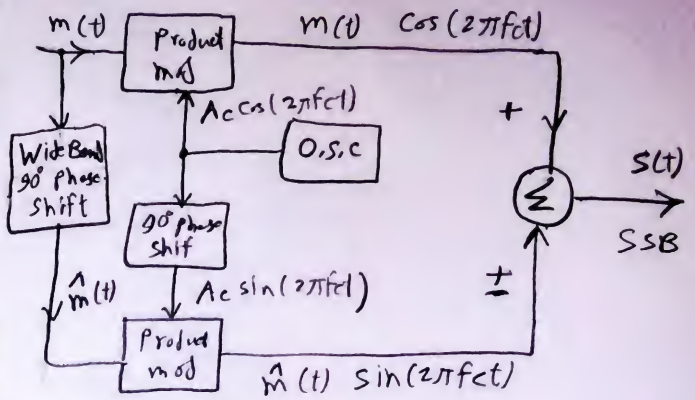




$f_c = f_1 + f_c$

② Phase discriminator Method:

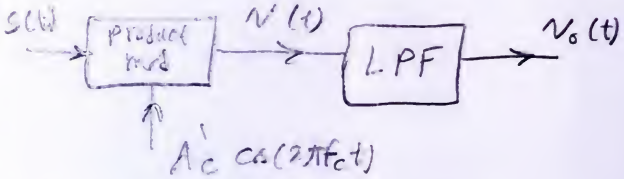
$$S(t) = \frac{A_c}{2}\left[m(t)\cos(2\pi f_c t) \pm \hat{m}(t)\sin(2\pi f_c t)\right]$$



★ DeModulation OF SSB:

① Coherent detector

* Product Mod and LPF



$$V(t) = S(t)\, A_c' \cos(2\pi f_c t)$$

$$= A_c' \frac{A_c}{2} m(t)\cos(2\pi F_c t)\cos(2\pi f_c t)$$

$$\pm A_c' \frac{A_c}{2} \hat{m}(t)\sin(2\pi f_c t)\cos(2\pi f_c t)$$

$$= \frac{A_c A_c'}{4}\left[1+\cos(4\pi f_c t)\right] m(t)$$

$$\pm \frac{A_c A_c'}{4}\left[\underbrace{\sin(0)}_{\to 0} + \sin(4\pi f_c t)\right]\hat{m}(t)$$

$$= \frac{A_c A_c'}{4}\left[m(t) + m(t)\cos(4\pi f_c t)\right]$$

$$\pm \frac{A_c A_c'}{4}\hat{m}(t)\sin(4\pi f_c t)$$

after LPF

$$V_o(t) = \frac{A_c A_c'}{4} m(t)$$